MULTIMEDIA UNIVERSITY

STUDENT ID NO

Seat No.: | | | |

Venue: _____

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

TCP2101 – ALGORITHM DESIGN AND ANALYSIS

(All sections / Groups)

6 MARCH 2020
9.00 a.m. – 11.00 a.m.
(2 Hours)

Question No.	Marks
1	
2	
3	
4	
Total	

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 9 pages with 4 Questions only.

2. Answer **ALL FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers CLEARLY in this Question paper.

QUESTION 1

a) An algorithm named LMN is provided below.

i) Fill in the two blanks for the number of primitive operations in the table.

[2 marks]

Algorithm LMN Input: An array A[0,...,n − 1] of numbers	Number of Primitive Operations
v = A[0]	
for i = 1 to n − 1	
if A[i] > v	
v = A[i]	
return v	
T(n)	

ii) Given an array A = {1, 2, 7, 3, 9, 4}, what is the value of the "return v" from the algorithm above. [1 mark]

iii) What is the functionality of the algorithm LMN? [1 mark]

b) Given an array, A = {34, 55, 12, 17, 45, 37, 75, 86, 65} to be inserted into a hash table with the size 10. The hash function is h(x) = x % 10.

i) What is the load factor of the hash table? [1 mark]

ii) Is the given hash function good for uniform hashing? Explain your answer.

[2 marks]

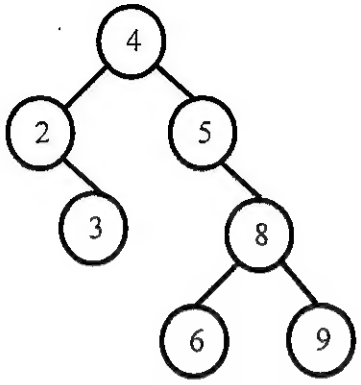
iii) Among the two collision resolutions: chaining and probing, which collision resolution do you think is better to solve the collisions in the hash table above? Why?

[2 marks]

Continued...

c) Show the resulting structure after deleting node 5 from the following BST.

[1 mark]



QUESTION 2

a) What is the time complexity in Theta notation for each algorithm in the table below?

[2 marks]

Algorithm	Time complexity
Enqueuing elements one at a time to form a heap	
Forming an initial heap out of elements	

b) Differentiate between the full binary tree and complete binary tree in the table below.

[2 marks]

Full Binary Tree	Complete Binary Tree

Continued...

c) Build an initial heap from the numbers below. Then, apply heapification step-by-step to form a maxheap. [3 marks]

30 28 34 14 29 32 57 7 26

d) Construct a graph based on the following adjacency matrix. A, B and C are the nodes. F = False and T = True. [1 mark]

	A	B	C
A	F	T	T
B	T	F	F
C	F	F	F

Continued...

e) Complete the pseudocode for the Quick-sort algorithm below. [2 marks]

Algorithm quicksort(S, p, r):
Input: array S, start index p, end index r.
Output: S is sorted.

```
if p < r
    pi = partition(S, p, r)
```

QUESTION 3

a) Find the time complexity T(n) for the following recurrence equations using the provided Master Theorem method.

(i) $T(n) = 25T(n/5) + n^3$
(ii) $T(n) = 16T(n/2) + n^2 \log n$
(iii) $T(n) = 3T(n/3) + n$

Master Theorem method:

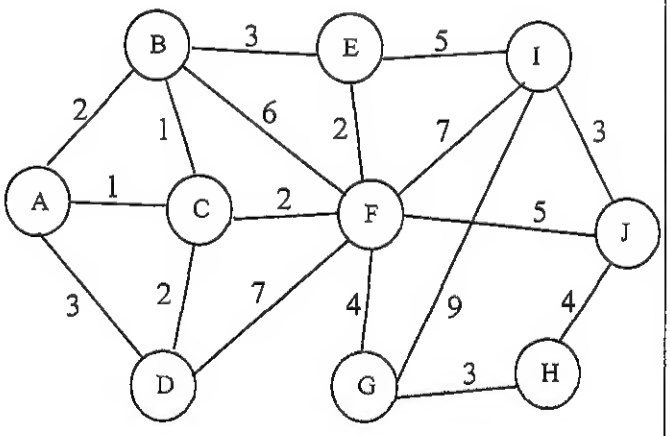
1. if $f(n)$ is $O(n^{\log_b a - \varepsilon})$, then $T(n)$ is $\Theta(n^{\log_b a})$
2. if $f(n)$ is $\Theta(n^{\log_b a} \log^k n)$, then $T(n)$ is $\Theta(n^{\log_b a} \log^{k+1} n)$
3. if $f(n)$ is $\Omega(n^{\log_b a + \varepsilon})$, then $T(n)$ is $\Theta(f(n))$, provided $af(n/b) \leq \delta f(n)$ for some $\delta < 1$.

[3 marks]

Continued...

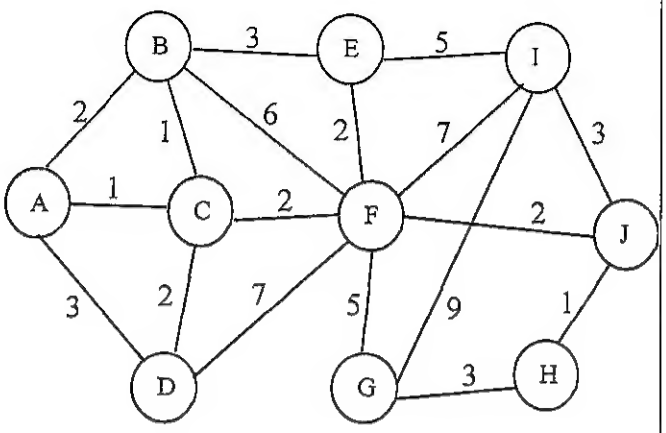
b) Given five (5) numbers: 234, 100, 101, 252, 111
Sort the numbers using **Merge sort** algorithm. Show the steps for the sorting.
[4 marks]

c) Find the Minimum Spanning Tree (MST) from each of the graphs below using
(i) Prim's algorithm if the initial node is B. What is the total weight? [1.5 marks]



Continued...

(ii) Kruskal's algorithm. What is the total weight? [1.5 marks]



QUESTION 4

a) A programmer wishes to sort a list of alphabets and the algorithm he chooses should fulfill the two conditions below:
- Stable (to keep the words with the same sorting key in order)
- Not in-place (to store the result in additional/temporary data structure)

(i) Which of the following algorithms should the programmer choose?
Selection-sort, Quick-sort, Heap-sort, Merge-sort

(ii) Regardless of the two conditions above, if the main concern is the speed, which of the four algorithms in (i) should the programmer choose?

(iii) What is the time complexity for the Heap-sort if the alphabets are inserted sequentially?

[1.5 marks]

Continued...

b) Given six (6) items and their weights and benefits listed in the table below, use **0/1 knapsack algorithm** to find the items with maximum total benefit. Ensure that the total weight is at most 10 kg.

Items	A	B	C	D	E	F
Weight (kg)	6	1	2	4	5	3
Benefit (RM)	12	5	4	12	10	12

[4.5 marks]

Items\Weight	0	1	2	3	4	5	6	7	8	9	10

Continued...

c) Apply Boyer-Moore's algorithm to find the **pattern** in the **text** provided below. Show the **pattern** matching in steps.
pattern = WORRIER

text = I AM A WARRIOR NOT A WORRIER

[3 marks]

I		A	M		A		W	A	R	R	I	O	R		N	O	T		A		W	O	R	R	I	E	R
I		A	M		A		W	A	R	R	I	O	R		N	O	T		A		W	O	R	R	I	E	R
I		A	M		A		W	A	R	R	I	O	R		N	O	T		A		W	O	R	R	I	E	R
I		A	M		A		W	A	R	R	I	O	R		N	O	T		A		W	O	R	R	I	E	R
I		A	M		A		W	A	R	R	I	O	R		N	O	T		A		W	O	R	R	I	E	R
I		A	M		A		W	A	R	R	I	O	R		N	O	T		A		W	O	R	R	I	E	R

d) **Sudoku** (picture below referred) is a logic-based, combinatorial number-placement puzzle. The objective is to fill a 9×9 grid with digits so that each column, each row, and each of the nine 3×3 subgrids that compose the grid contain all of the digits from 1 to 9. Why does Sudoku fall under NP class (Non-deterministic polynomial time)?

[1 mark]

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

The End..